

COMBIVERT



Instruction Manual Power Supply Unit R5-C V1.1

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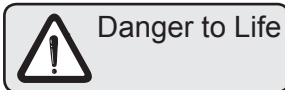
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1. Safety Instructions

The directions in this chapter must be absolutely observed for the following reasons:

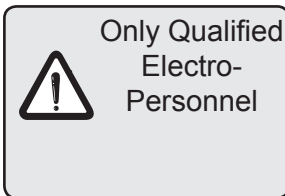
- **Safety for people and machines**
- **Function and susceptibility to faults**
- **Technical inspectorate acceptance and certification**
- **Guarantee and warranties**

General



KEB electronics components contain dangerous voltages which can cause death or serious injury. During the operation and depending on the type of protection, they can have live, bright, possibly also mobile parts as well as hot surfaces.

Care should be taken to ensure correct and safe operation to minimise risk to personnel and equipment.

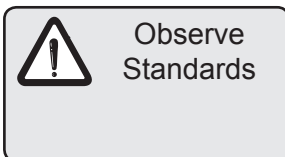


All work from the transport, to installation and start-up as well as maintenance may only be done by qualified personnel (IEC 364 and/or CENELEC HD 384 and IEC-Report 664 and note national safety regulations). According to this manual qualified staff means those who are able to recognise and judge the possible dangers based on their technical training and experience and those with knowledge of the relevant standards and who are familiar with the field of power transmission (VDE 0100, EN 50178, EN 60204 as well as the appropriate regulations for your area).

Intended use

KEB electronics components are drive components which are intended for installation into electrical systems or machines. They serve exclusively for stepless speed regulation / control of three-phase asynchronous / permanent magnet motors. Use for other purpose is not recommended and may lead to equipment damage.

The inverter / servo drive must not be started until it is determined that the installation complies with 89/392/EEC (machine directive) as well as the EMC-directive (89/336/EEC)(note EN 60204).



The frequency inverters / servo drives meet the requirements of the Low-Voltage Directive 73/231/EEC. The harmonized standards of the series EN 50178 in connection with EN 60439-1 and EN 60146 were used.

Transport, Storage and Installation

The storage of the COMBIVERT must be done in the original packing. It is to be protected against humidity and excessive cooling and thermal effect. A long-distance transport must be carried out in the original packing. It is to be secured against impact influence. The marking on the final packing must be observed! After removing the final packing the COMBIVERT must be set down on a stable base.

Safety and Application Instructions



Protect
Against
Accidental
Contact

Inverters / servo drives must be protected against physical damage during transport, installation and use. Components and covers must not be bent or moved as this may affect insulation distances. The units contain electrostatically endangered components which can be destroyed by inappropriate handling. For that reason the contact of electronic components and contacts is to be avoided. The equipment must not be switched on if it is damaged as it may no longer comply with mandatory standards.

Make sure that during installation there is enough minimum clearance and enough cooling. Climatic conditions must be observed in accordance with EN 50178.

Electrical Connection



Note capacitor
discharge
time

Before any installation and connection work, the system must be switched off and secured.

After clearing the intermediate circuit capacitors are still charged with high voltage for a short period of time. The unit can be worked on again, after it has been switched off for 5 minutes.



Control lines

With frequency inverters that are not isolated from the supply circuit (EN 0100) all control lines must be included in other protective measures (e.g. double insulation or shielded, earthed and insulated).



Voltage with
respect to
ground

Connection of the frequency inverter / power controller is only permissible on symmetrical networks with a maximum line voltage (L1, L2, L3) with respect to earth (N/PE) of 300V. An isolating transformer must be used for supply networks which exceed this value! The units may be damaged if this is not observed.



Only Fixed
Connection

The frequency inverters are designed for fixed connection only as discharge currents of > 3.5 mA may occur especially when using filters. It is necessary to lay a protective conductor with a section of at least 10 mm² copper or a second conductor electrically parallel to the protective conductor via separate terminals. Ground point-to-point with the shortest connection possible to mains earth (avoid earth loops).



Voltage
Peaks

When using IGBT inverters, high voltage peaks may arise in the motor due to the switching action of the inverter output devices. These voltage peaks may damage the insulation of the motor winding and must be taken into account when using motor cables longer than 15m with high frequency motors. In this case, the motor can be protected with a motor choke, dv/dt filter or sine filter.



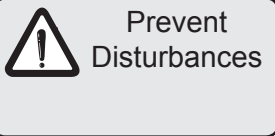
Insulation
Measurement

When doing an insulation measurement in accordance with VDE 0100 / Part 620, the power semiconductor of the unit and existing radio interference filters must be disconnected because of the danger of destruction. This is permissible in compliance with the standard, since all inverters are given a high voltage test in the end control at KEB in accordance with VDE 0160 (EN 50178).



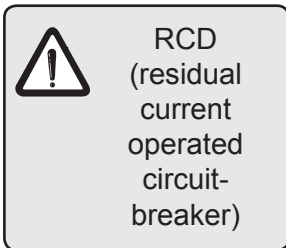
Different
Earth
Potentials

When using components without isolated inputs / outputs, it is necessary that equipotential bonding exists between the components to be connected (e.g. through the equalizer). Disregard can cause destruction of the components by the equalizing currents.



A trouble-free and safe operation of the frequency inverters / servos is only guaranteed when the connection instructions below are strictly followed. Incorrect operation or damage may result from incorrect installation.

- *Note mains voltage and rated motor voltage.*
- *Install power cables and control cables separately (>15 cm separation).*
- *Use shielded / twisted control lines. Connect shield to PE at inverter only!*
- *Only use suitable circuit elements to control the logic and analog inputs, whose contacts are rated for extra-low voltages.*
- *Make sure inverter and motor housing are well grounded. The screen of the power cable must be directly and securely attached to both the inverter PE terminal and the motor ground terminal. Remove paint finish where necessary.*
- *Connect the braking module / braking resistor with shielded / twisted cables (install shield on one side of the inverter)*
- *Ground the cabinet or the system earth star point with the shortest connection to mains earth (avoid earth loops)*



If personnel protection is required during installation of the system the frequency inverters must be protected according to EN 50178 (VDE 0160):

- *1-phase inverters by RCD type A (pulse-current sensitive FI's) or type B (all-current sensitive FI's)*
- *3-phase inverters (with B6 bridge-connected rectifier) by RCMA's with separation (used privileged) or RCD's type B (all-current sensitive FI's)*

The tripping current should be 300mA or more, in order to avoid a premature triggering of the inverter by discharge currents (about 200mA).

Dependent on the load, the length of the motor cable and the use of a radio interference filter, substantially higher leakage current can occur.

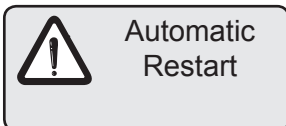
The connection instructions from the manufacturer and the valid local requirements must be observed.

Dependent on the available mains form (TN, IT, TT) further protective measures are necessary in accordance with VDE Part 410 (Part 4; Chapter 41).

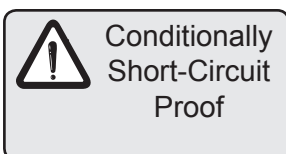
For example, with TN-mains this protection is made with overcurrent protective devices, with IT-mains it is insulation monitoring with a pulse-code measuring method. A protective separation can be used with all mains forms as long as the required power and cable lengths permit this.

Operating Instructions

Before putting the unit into operation, check terminals and screw connections for tight fit and put back all pertaining covers.



Inverters/servo drives may be set, dependent on type, to restart automatically following a fault stoppage (e.g. Undervoltage Error), when the fault conditions clear. System design must take this into account, if appropriate, and additional monitoring or protective features added where necessary.



The frequency inverters / servo drives are conditionally short-circuit proof (EN 50178/VDE 0160). After resetting the internal protection devices, the function as directed is guaranteed. Exceptions:

- *If an earth-leakage fault or short-circuit often occurs at the output, this can lead to a defect in the unit.*
- *If a short-circuit occurs during regenerative operation (2nd or 4th quadrant, feedback into the intermediate circuit), this can lead to a defect in the unit.*

2. Product Description

With R5-C COMBIVERT you have acquired a DC supply unit with the highest demands on security and reliability.

This instruction manual describes the supply unit KEB COMBIVERT R5-C of the 400-V class in a range of 30 kW...250 kW.

2.1 Specified Application

The COMBIVERT R5-C serves exclusively for supply of frequency inverters with DC supply. The operation of other electric consumers is prohibited and can lead to the destruction of the unit!

2.2 Features of the COMBIVERT R5-C

- Degree of protection IP20
- Extensive protection against overcurrent, ground fault and temperature
- Short-circuit proof (with corresponding dimensioned mains fuses)

2.3 Unit identification

2	3	.	R	5	.	C	1	R	-	9	0	R	0			
														Cooling	A: default	
														Design	0: default	
														free	0: default	
														Voltage	9: 3ph; 400 V; AC	
														Housing	G; R	
														Options	0: without	3: precharging; DC-fuses
															1: precharging	4: GTR7; precharging; DC-fuses
															2: GTR7; precharging	
														Control board	0: none	C: 2C.F5
														Unit type	R5	
Size	19; 23; 25; 27; 28; 29															

2.4 Technical data

Rectifier size	19	23	25	27	28	29
Housing size	R	R	R	U	U	U
Chargeable inverter power ¹⁾ [kW]	30	75	110	160	200	250
DC nominal output current [A _{DC}]	90	180	270	380	470	610
Max. short time current ²⁾ [A _{AV}]	135	270	405	570	705	915
OL current [A _{DC}]	153	306	459	646	799	1037
Input current ³⁾ [A _{RMS}]	79,8	147,5	221	312	386	500
Mains voltage [V AC _{RMS}]	305...504 +/- 0%					
Phases	3					
Output voltage [V DC]	430...713					
Maximal permissible mains fuse [A]	100	200	350	500	710	710
I ² t mains fuse [A ² s]	<19.100	<128.000	<236.000	<423.000	<1.062.000	<1.062.000
Supply line cross section (min) [mm ²]	35	95	150	2x150	2x185	2x185
Supply line cross section (max) [mm ²]	95	150	150	2x185	2x185	2x185
DC line cross section (min) [mm ²]	50	120	150	2x150	2x150	4x95
DC line cross section (max) [mm ²]	95	150	150	4x185	4x185	4x185
Storage temperature [°C]	-25...70					
Operation temperature [°C]	-10...45					
Climatic category (EN 60721-3-3)	3K3					
Protective system	IP20			IP00		
Power loss at nominal operating [W]	ca. 220	ca. 400	ca. 600	ca. 1050	ca.1200	ca.1600
Max. heat sink temperature [°C]	90					
Internal braking option	Option					
Max. braking current [A]	133	133	200	250	250	250
Min. braking resistor [Ohm]	6	6	4	3,2	3,2	3,2
Typ. braking resistor [Ohm]	15	6,7	4,3	4,3	3,2	3,2
Line cross section braking resistor [mm ²]	35...95			16...185		
Weight [kg]	28		49		54	56

- ¹⁾ The typical inverter ratings are only assignment references for the components. The drive powers are dependent on the connected motors and must be designed accordingly.
- ²⁾ The max. short time current limit is specified for 1 minute. The overload cycle is 300 seconds. This corresponds to duty class 2 EN 60146-1-1.
- ³⁾ The current data are based on a fundamental frequency component of $g=0,75$. The fundamental frequency component or the effective value of the input current is dependent on load and line supply conditions. At uncontrolled B6 converters the phase angle $\cos\phi_1$ can be set to one, so the value of the fundamental frequency components is equal to the value of the power factor.



The units are not short circuit proof without corresponding dimensioned fuses

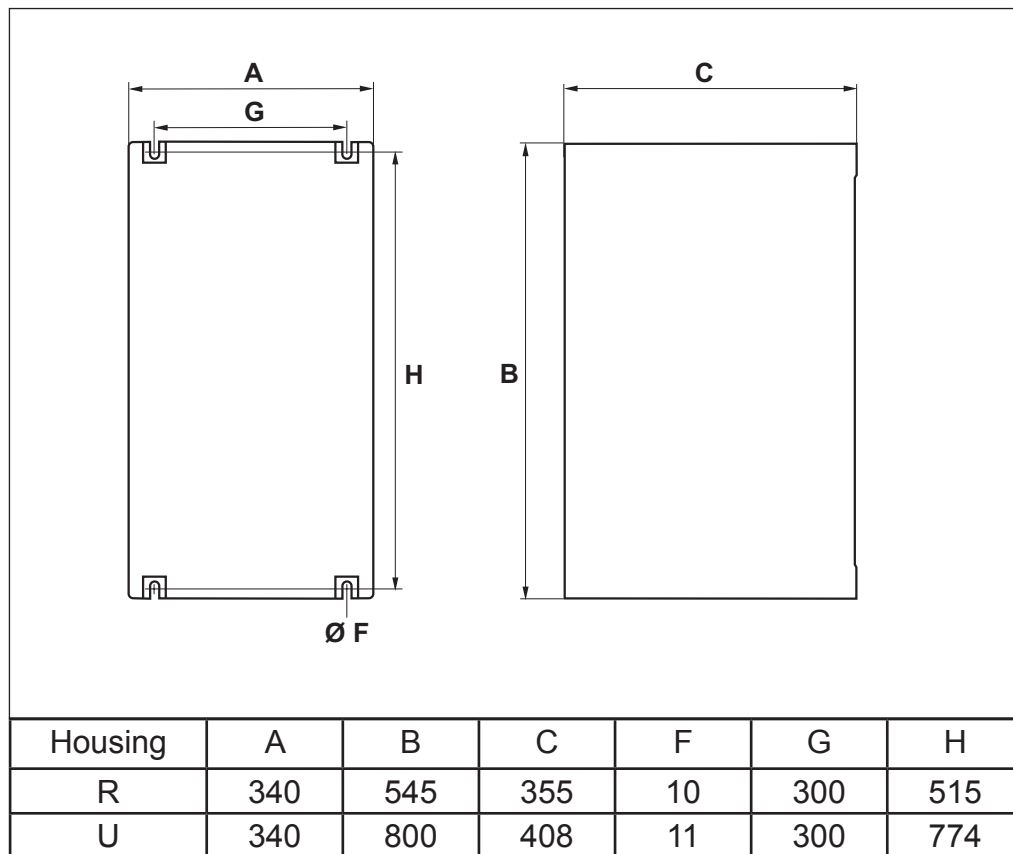
The max. loadable DC link capacity is 100000 µF. Exceeding the capacity triggers the error "charge time out" (E.cto).

Do not charge the DC link during the load cycle.

3. Installation

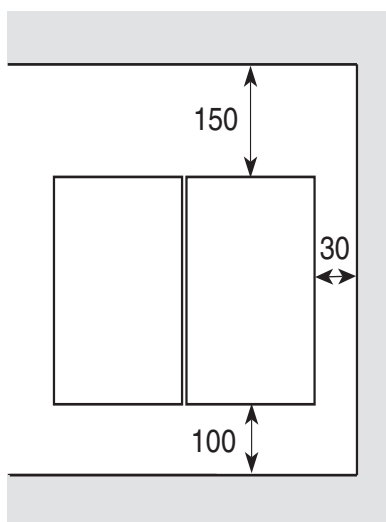
3.1 Unit Installation

3.1.1 Dimensions



3.1.2 Installation Instructions

The COMBIVERT R5 is provided for vertical installation. The following minimum distances must be observed:



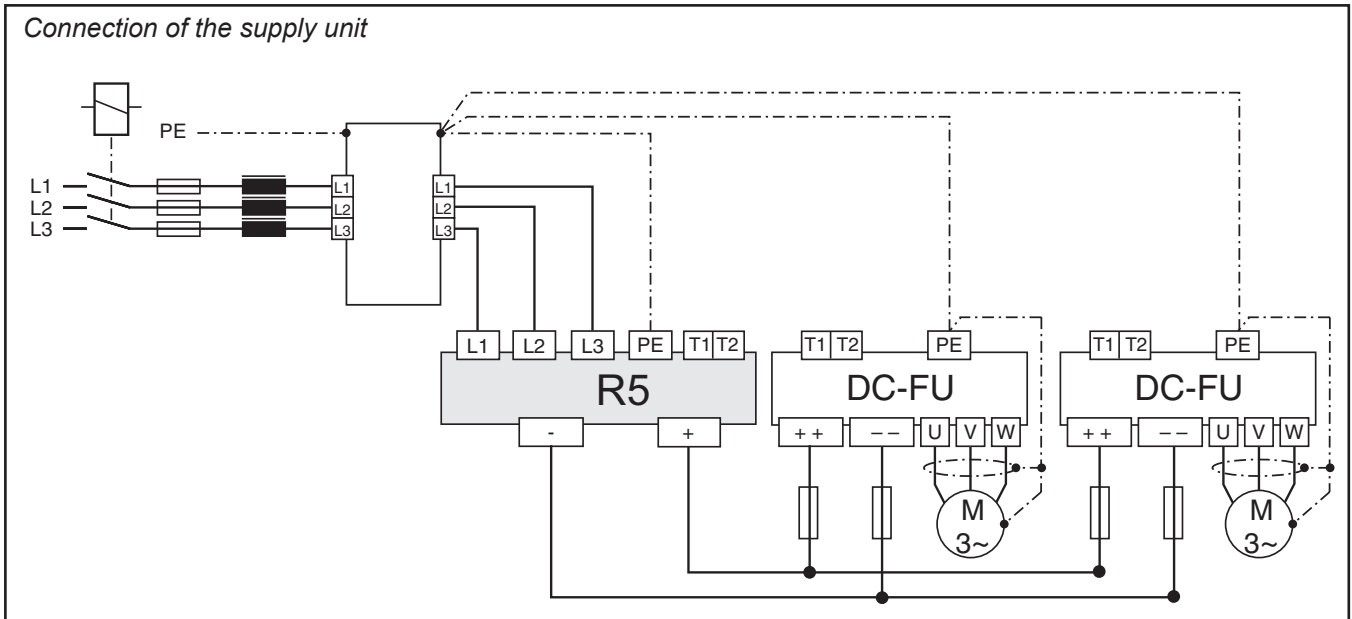
3.2 Connection of the Power Unit

3.2.1 Mains Connection of the Supply Unit

- absolutely use a line reactor
- in case of interconnected operation with several supply units consider information sheet 00.R5.0DM-I000 !



Switching at the input without waiting of an under-potential error (E.UP) causes high wear of the switching contacts. Fuses and overcurrent protection units can release furthermore. See publication ENG 000 0001.



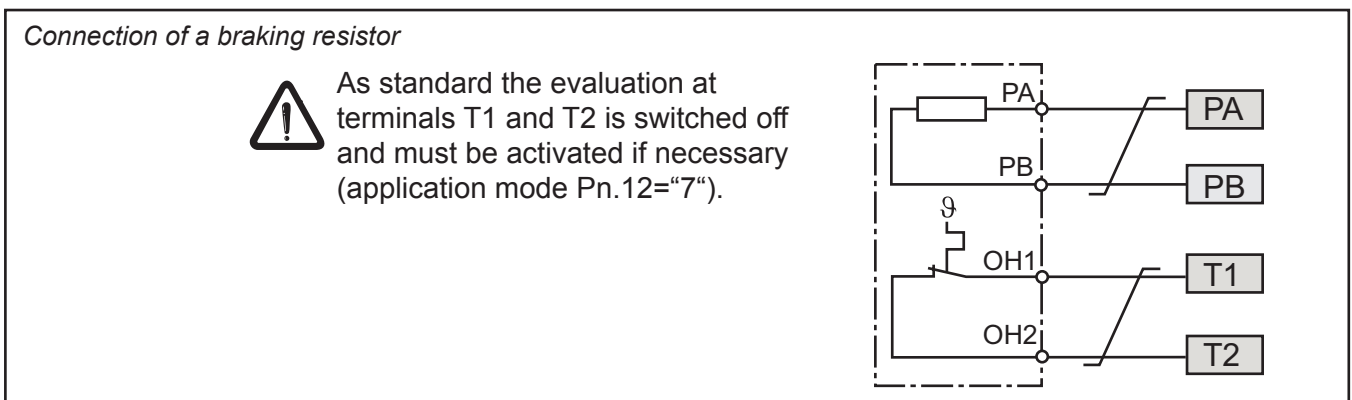
3.2.2 Connection of the Braking Resistor

It is absolutely necessary to monitor the braking resistance temperature switch to record a braking resistance overheat. The overheat may be caused by:

- incorrect dimensioning of the braking resistance
- the input voltage being too high

The current of the brake transistor is monitored additionally. The input thyristors are switched off in case of a short circuit.

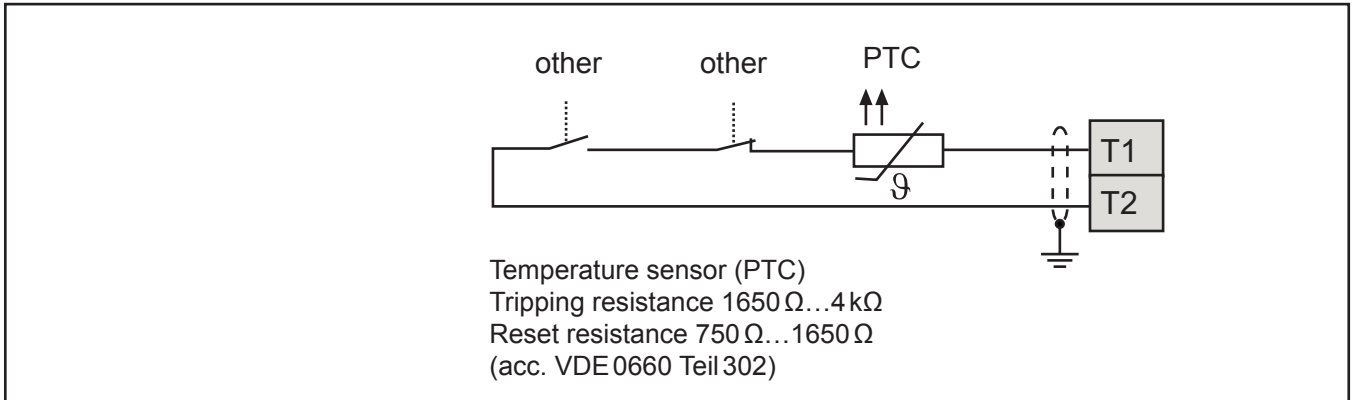
Braking resistors can develop a very high surface temperatures, therefore install as safe-to-touch as possible!



3.2.3 Connection of a Temperature Detection

An external temperature sensor/switch can be connected to the terminals T1, t2 . The supply unit switches off with the error message E.OH during tripping.

As standard the evaluation at terminals T1 and T2 is switched off and must be activated if necessary (application mode Pn.12="7").



3.3 Instructions of an EMC-conform Installation

- To avoid coupled-in noise, separate
 - a) Line-supply cables,
 - b) Motor lines of frequency inverters/servo power controller,
 - c) Lay control and data lines (low-voltage level <48V), with a distance of at least 15 cm.
- In order to maintain low-resistance high frequency connections, earthing and shielding, as well as other metallic connections (e.g. mounting plate, installed units) must be in metal-to-metal contact with the mounting plate, over as large an area as possible. Use earthing and equipotential lines with a section as large as possible (min. 10 mm²) or use thick earthing strips.
- If external interference suppression filters are used, then these must be installed as close as possible to (<30 cm from) the interference source and in metal-to-metal contact with the mounting plate, over as large an area as possible.
- Always equip inductive control elements (contactors, relays etc.) with suppressors such as varistors, RC-elements or damping diodes.
- All connections must be kept as short as possible and as close as possible to the earth, as free floating lines work as active and passive aerials.
- Keep connection cables straight (do not bundle). Install a non-assigned wire on both sides of the protective conductor.
- The flow and return circuit must be twisted when the lines are not shielded, in order to dampen common-mode noise.
- As a general principle use metal cable glands with shield connection.

4. Installation and Connection

4.1 Control Card Version C

4.1.1 Assignment of the Terminal Strip X2A

X2A



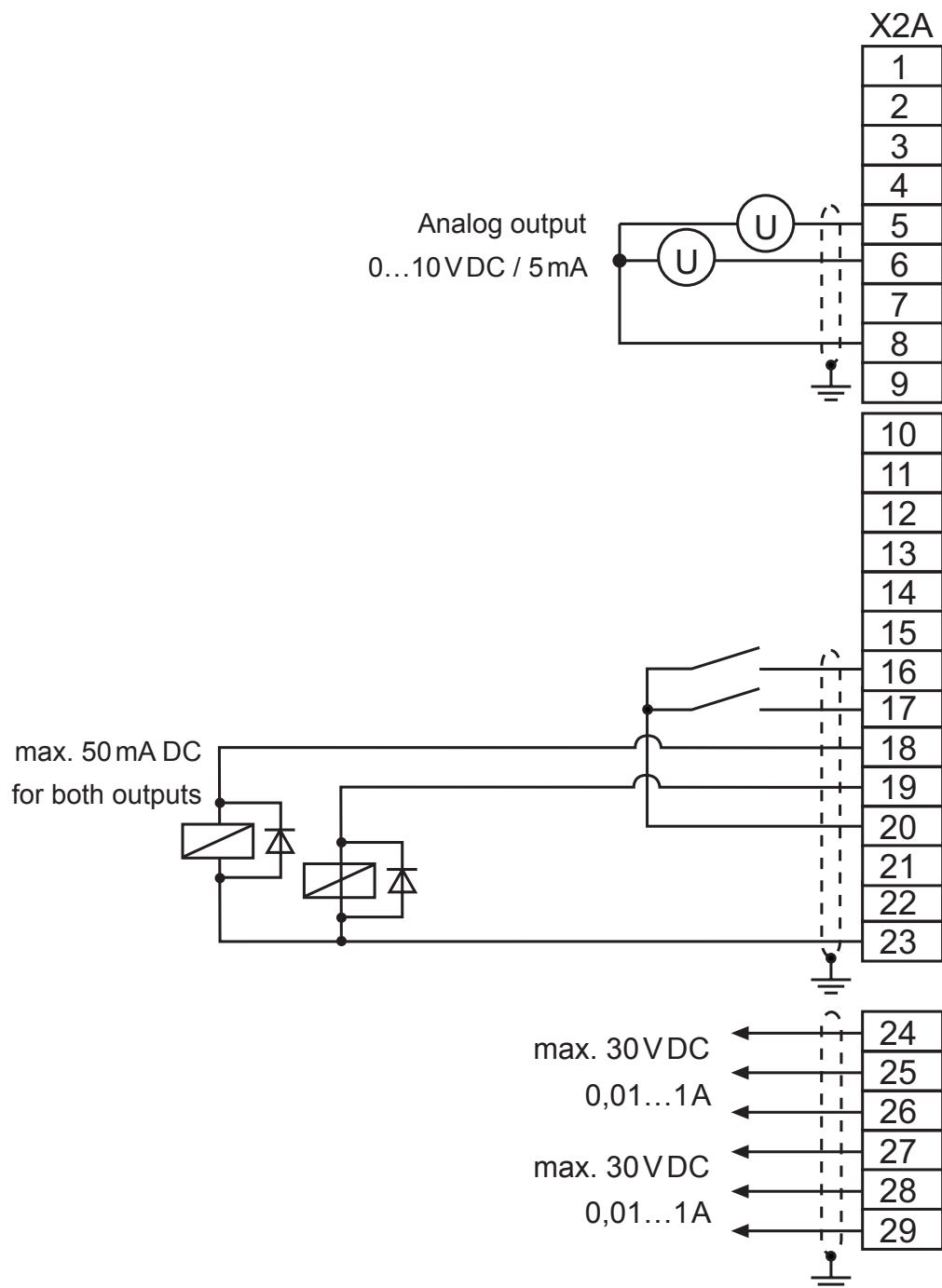
PIN	Function	Name	Explanation	
1...4	without function - -	-	-	
5	Analog output 1:	ANOUT1	Analog output of the DC output current 0...10 VDC \wedge 0...200 %	Voltage range: 0...±10V Ri: 100Ω Resolution: ±10 bit
6	Analog output 2:	ANOUT2	Analog output of the DC voltage 0...10 VDC \wedge 0...1000VDC	
7	without function - -	-	-	
8	Analog mass	COM	Mass for analog in- and outputs	
9	Analog mass	COM		
10	without function - -	I1	-	Ri: 2,1 kΩ Scan time: 4 ms
11	without function - -	I2	-	
12	without function - -	I3	-	
13	without function - -	I4	-	
14	Slave input	I5	only interconnected operation 00.R5.0DM-I000	
15	without function - -	I6	-	
16	Start	ST	Thyristors switched through Error reset during opening	
17	Reset	RST	Reset; only possible in fault condition	
18	Transistor output 1	O1	„Run“; is set, if the thyristors are switched trough	
19	Transistor output 2	O2	„Error“ is set, if the unit switched off on error	
20	24V-output	Uout	Power supply for digital inputs	I _{max} : 100 mA
21	without function - -	-	-	
22	Digital ground	0V	Reference potential for digital in-/outputs	
23	Digital ground	0V		
24	Relay 1 / NO contact	RLA	Relay output Ready for operation signal	max. 30 V DC 0,01...1 A
25	Relay 1 / NC contact	RLB		
26	Relay 1 / switching contact	RLC		
27	Relay 2 / NO contact	FLA	Relay output phase error warning	
28	Relay 2 / NC contact	FLB		
29	Relay 2 / switching contact	FLC		

4.1.2 Control Connection

In order to avoid malfunctions caused by interference voltage supply at the control inputs, the following instructions must be observed:



- Use shielded/drilled cables
- Lay shield on one side of the inverter onto earth potential
- Lay power and control cable separately (about 10...20 cm distance); lay cables in a right angle



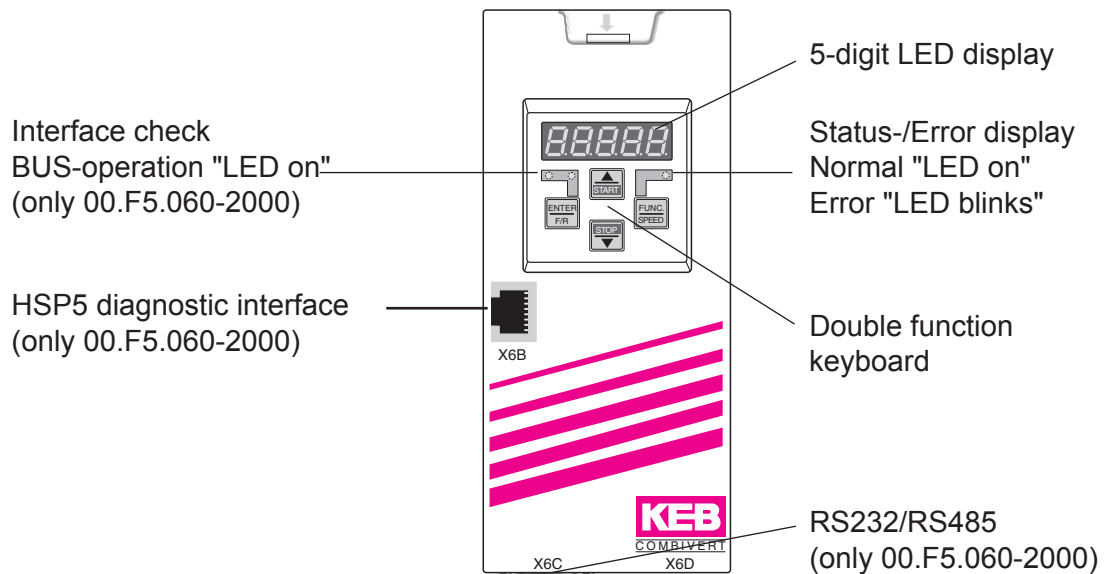
5. Operation of the Unit

An operator is necessary as accessories for local or external (Option: cable 00.F5.0C0-1xxx) programming of the frequency inverter KEB COMBIVERT. In order to avoid malfunctions the frequency inverter must be brought into status nOP before plug-on/remove of the operator (open control release). During starting of the frequency inverter it always starts with the last stored values/factory setting.

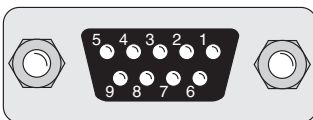
5.1 Operator

Digital operator with operation and display: Part No. 00.F5.060-1000

Interface operator additionally with serial interface: Part No. 00.F5.060-2000

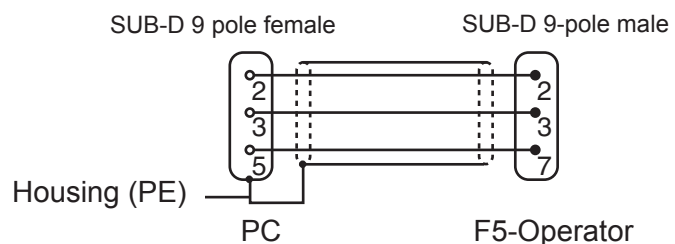


Use only the operator interface for the serial data transfer according to RS232/485. The direct connection of a PC to a frequency inverter is only permissible with a **special cable** (HSP5 Part No. 00.F5.0C0-0001), otherwise it would lead to the destruction of the PC interface!



PIN	RS485	Signal	Meaning
1	-	-	reserved
2	-	TxD	transmission signal RS232
3	-	RxD	receive signal RS232
4	A'	RxD-A	receive signal A RS485
5	B'	RxD-B	receive signal B RS485
6	-	VP	voltage supply plus +5V (I _{max} =10mA)
7	C/C'	DGND	data reference potential
8	A	TxD-A	transmission signal A RS485
9	B	TxD-B	transmission signal B RS485

RS232-cable 3m
PC / Operator
Part. No. 00.58.025-001D



Operation of the Unit

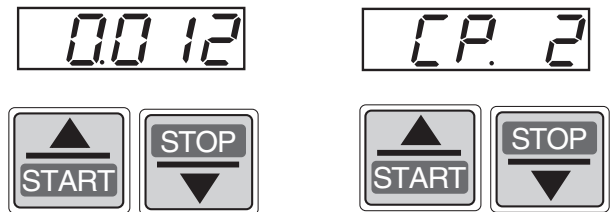
5.1.1 Keyboard

When switching on KEB COMBIVERT R5 the value of parameter CP.1 is displayed. (change-over of the keyboard function see Drivemode)

The function key changes between the parameter value and parameter number.



With UP and DOWN the value of the parameter number is increased/decreased with changeable parameters.



Principally during a change, parameter values are immediately accepted and stored non-volatile. However, with some parameters it is not useful that the adjusted value is accepted immediately. When this type of parameter is changed a point appears behind the last digit.

The adjusted value is accepted and non-volatile stored with ENTER.



If a malfunction occurs during operation, the actual display is overwritten by the alarm message. The alarm message in the display is reset by ENTER.



With ENTER only the error message in the display is reset. In order to reset the error itself, the cause must be removed or a power-on reset must be made. The present error is displayed in the status display (CP. 1).

5.2 Parameter summary

The CP parameters are one of the parameter selection defined by KEB. You need an application manual in order to get access to the entire parameters.

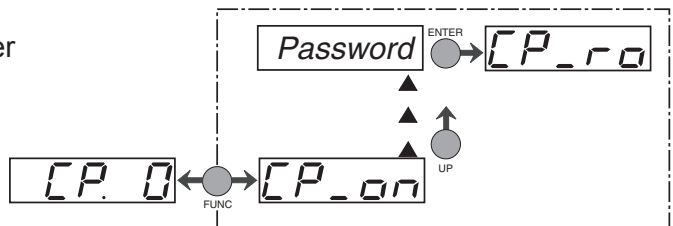
Display	Parameter	Setting range	Resolution	Fact. setting
CP. 0	Password input	0...9999	1	–
CP.1	Status display	–	–	–
CP.2	AC input current	–	0,1A	–
CP.3	DC output current	–	0,1A	–
CP.4	DC - output current / peak value	–	1 %	–
CP.5	current DC - utilization	–	1V	–
CP.6	current DC - voltage	–	1V	–
CP.7	DC output voltage	–	1V	–
CP.8	DC - output voltage / peak value	–	1V	–
CP.9	Heat sink temperature	–	1°C	–
CP.10	Charging time factor	100...500%	1%	100%
CP.11	Analog output 1 gain	-20,00...20,00	1	1,00
CP.12	Analog output 2 gain	-20,00...20,00	0,01	1,00
CP.13	AC-Phase current L1	–	0,1A	–
CP.14	AC-Phase current L2	–	0,1A	–
CP.15	AC-Phase current L3	–	0,1A	–

5.3 Password input

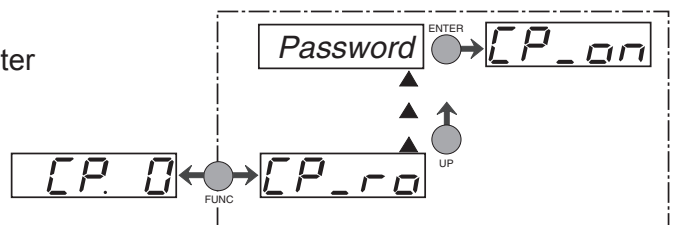


Ex works the frequency inverter is supplied without password protection, this means that all changeable parameters can be adjusted. After parameterizing the inverter can be secured against unauthorized access. The adjusted mode is stored.

Blocking the CP-Parameter



Releasing the CP-Parameter



Operation of the Unit

5.4 Parameter description

The following parameters serve for the functional monitoring during operation.

Status display



The status display indicates the actual operating condition of the inverter. Possible displays and their meaning:

noP	"no Operation" Starting terminal not bridged, thyristors blocked, output voltage = 0 V
run	"run" supply unit ready for operation; Thyristors connected
charG	"charge" DC output voltage is loaded on actual DC voltage "Ground Fault test" is displayed during power-on test.
GFt	Earth fault during power-on test
E.GF1	Earth fault during operation
E.GF2	"Error charge time out" DC output voltage could not be loaded within the adjusted charging time.
E.cto	"Error rectifier output" Difference between DC output voltage and actual DC voltage during the operation higher than 200 V.
E.rEco	"Error Phase failure" one input phase is failure (see 6.6.5)
E.UPh	

AC input current



Display of the average value of the effective input currents of phase L1...L3 in ampere.

DC output current



Display of the actual DC output current in ampere.

DC output current Peak value



This display enables a detection of short-term current peaks, as the highest value that occurred is stored.

The peak value can be reset with UP or Down when the unit is switched on. Switching off the unit deletes the peak value.

Actual DC gain



Display of the actual utilization of the supply unit in percent. 100 % correspond to the rated current.

**current DC -
voltage**



Display of the current DC voltage in volt. The value is measured in the charge circuit. The value serves as comparison value to the DC output voltage.

**DC output
voltage**



Display of the current DC output voltage in volt. The value is measured at the output terminals of the supply unit.

**DC output voltage
Peak value**



This display enables a detection of short-term voltage peaks, as the highest value that occurred is stored.

The peak value can be reset with UP or Down when the unit is switched on. Switching off the unit deletes the peak value.

**Heat sink
temperature**



Display of the actual heat sink temperature in °C. First a prewarning is given out if the heat sink temperature is too high, so a controlled deceleration of the unit is possible. The thyristors are blocked when reaching the max. heat sink temperature of 90° C, if there is no reaction to the pre-warning.

**Charging time
factor**



The charge time is dependent on the connected total capacity. The preset value of 100% is 16s. If the charge time should be exceeded in case of very large capacities, the charge time can be extended up to 500 % with the charge time factor.

**Analog output 1
gain**



At a gain of "1" the analog output 1 outputs a signal in a range of 0...10VDC = 0...150% I_{DC} which corresponds to the DC-output current. The gain can be adjusted with CP.11 in a range of $\pm 20,00$. The analog output can be adapted thereby to individual requirements.

**Analog output 2
gain**



At a gain of "1,00" the analog output 2 outputs a signal in a range of 0...10VDC = 0...800V U_{DC} which corresponds to the DC- output current. The gain can be adjusted with CP.11 in a range of $\pm 20,00$. The analog output can be adapted thereby to individual requirements.

AC-Phase current L1



CP.13 displays the rms value of the input current of phase L1 in ampere.

AC-Phase current L2



CP.14 displays the rms value of the input current of phase L2 in ampere.

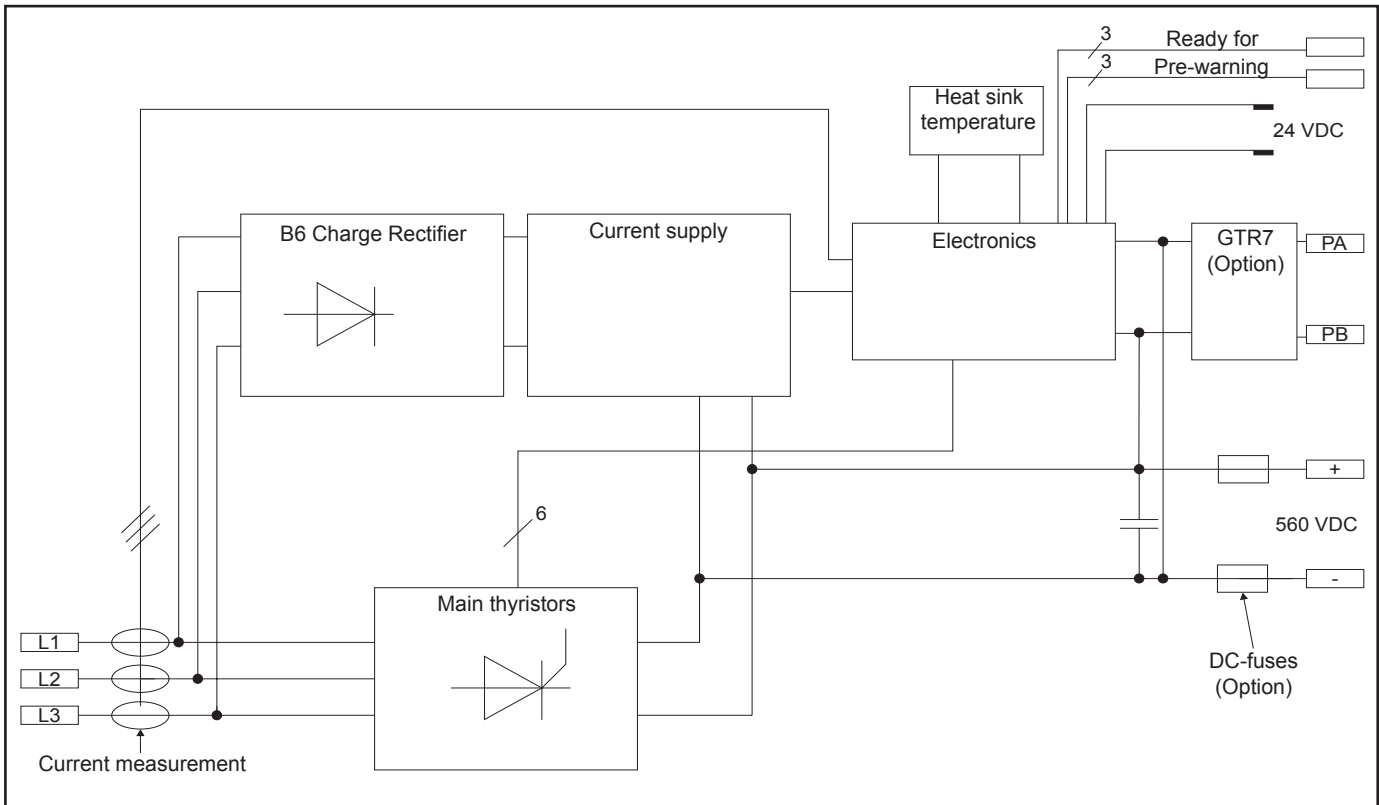
AC-Phase current L3



CP.15 displays the rms value of the input current of phase L3 in ampere.

6. Functional Description

6.1 Block Diagram of the Supply Unit



6.2 Switch-on procedure

The charging procedure of the connected frequency inverters starts with releasing mains voltage to the input terminals L1, L2, L3 and starting of the control. The pre-charging occurs via a current source, which enables loading of very high DC link capacities. The obtained charging time is depending on the value of the connected DC link capacities and the mains voltage. After executed pre-charging and checking the ground fault free at the DC bus the release of the thyristor block takes place. No phase angle control is executed, the thyristors are driven with 0° control angle, so the behaviour is like a B6-rectifier bridge.

The "RUN" - signal is set at the control terminals of the power supply unit and can be processed further by the master control. A load current may only be taken from the power supply unit after setting the "RUN" - signal, since otherwise a power off of the pre-charging unit occurs and an error message is output.

6.3 Power-Off the Supply Unit

Power-off occurs by disconnecting the mains voltage and/or the starting signal at the control card at the supply unit.

6.4 Error During Operation

An error signal is output on tripping the protective functions and the thyristors are switched off. The following operating conditions are supervised:

- Heat sink temperature
- Current
- Ground fault by differential current measurement

First a prewarning is given out if the heat sink temperature is too high, so a controlled deceleration of the unit is possible. The thyristors are blocked when reaching the max. heat sink temperature of 90 °C, if there is no reaction to the pre-warning.

6.5 Braking option

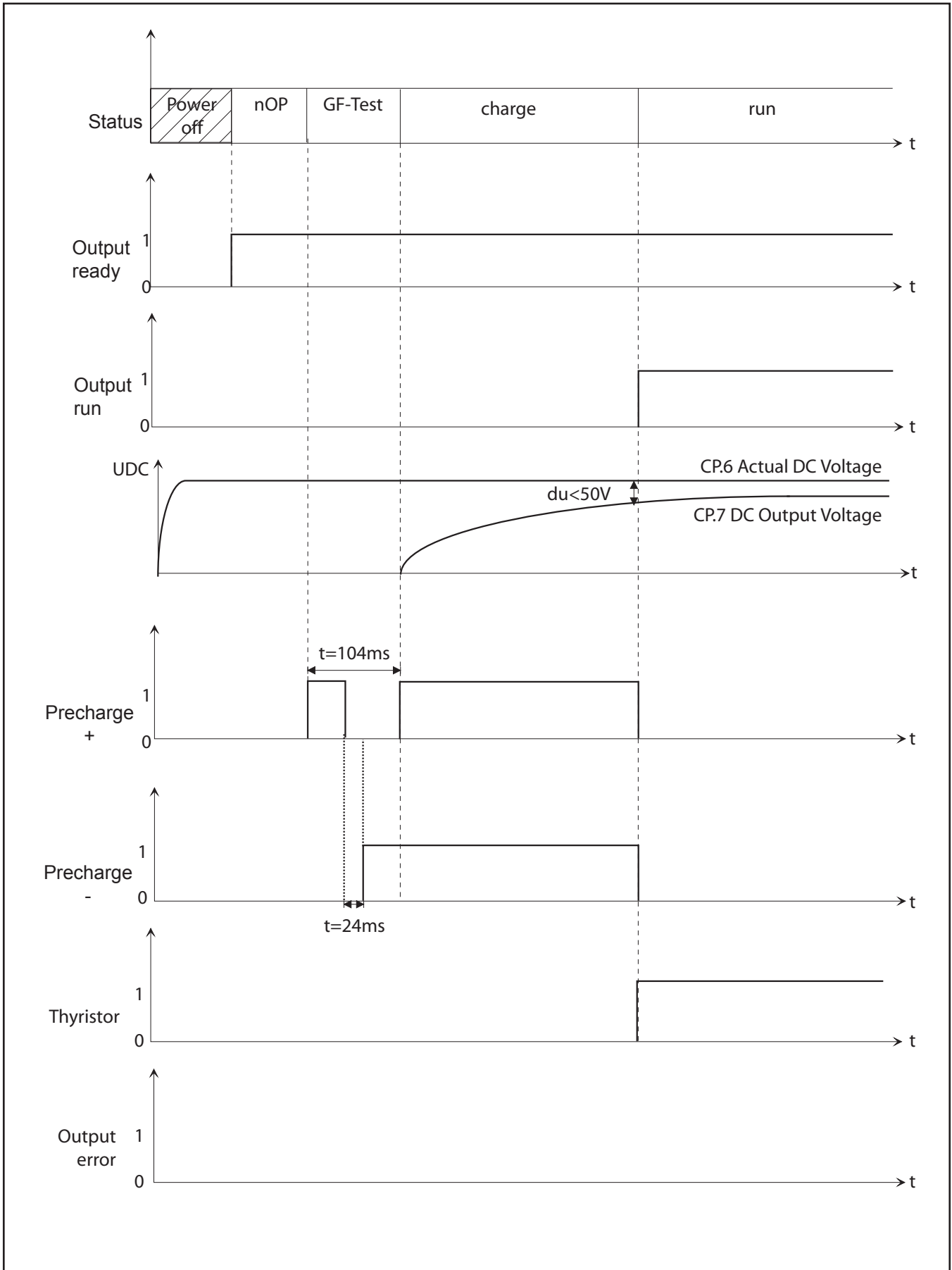
The brake transistor is controlled with a DC link voltage starting from 740 VDC.

6.6 Flow charts

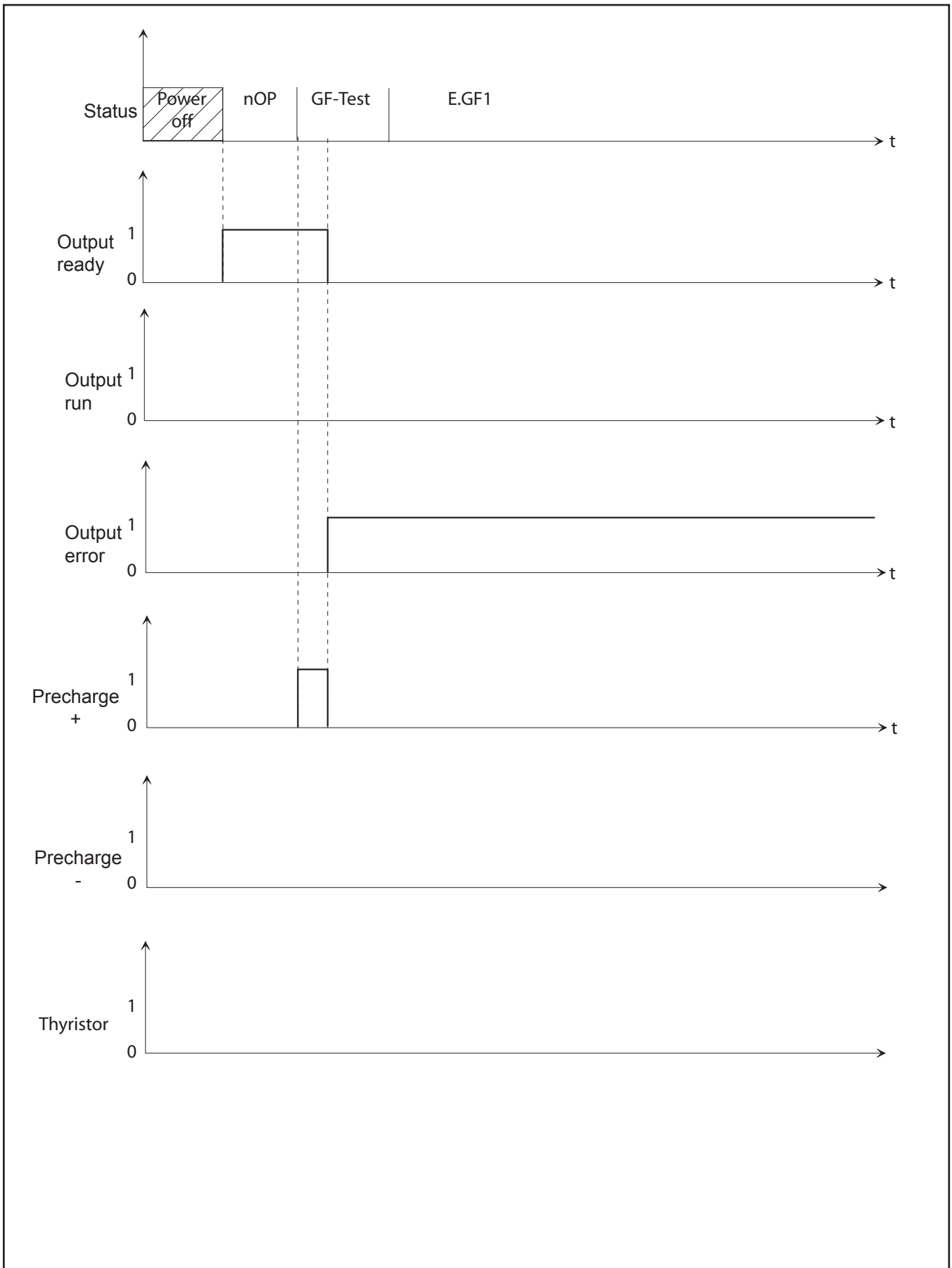
On the following pages there are some flow charts for a better understanding of the different operating conditions.

Functional Description

6.6.1 Power-on with Normal Conditions

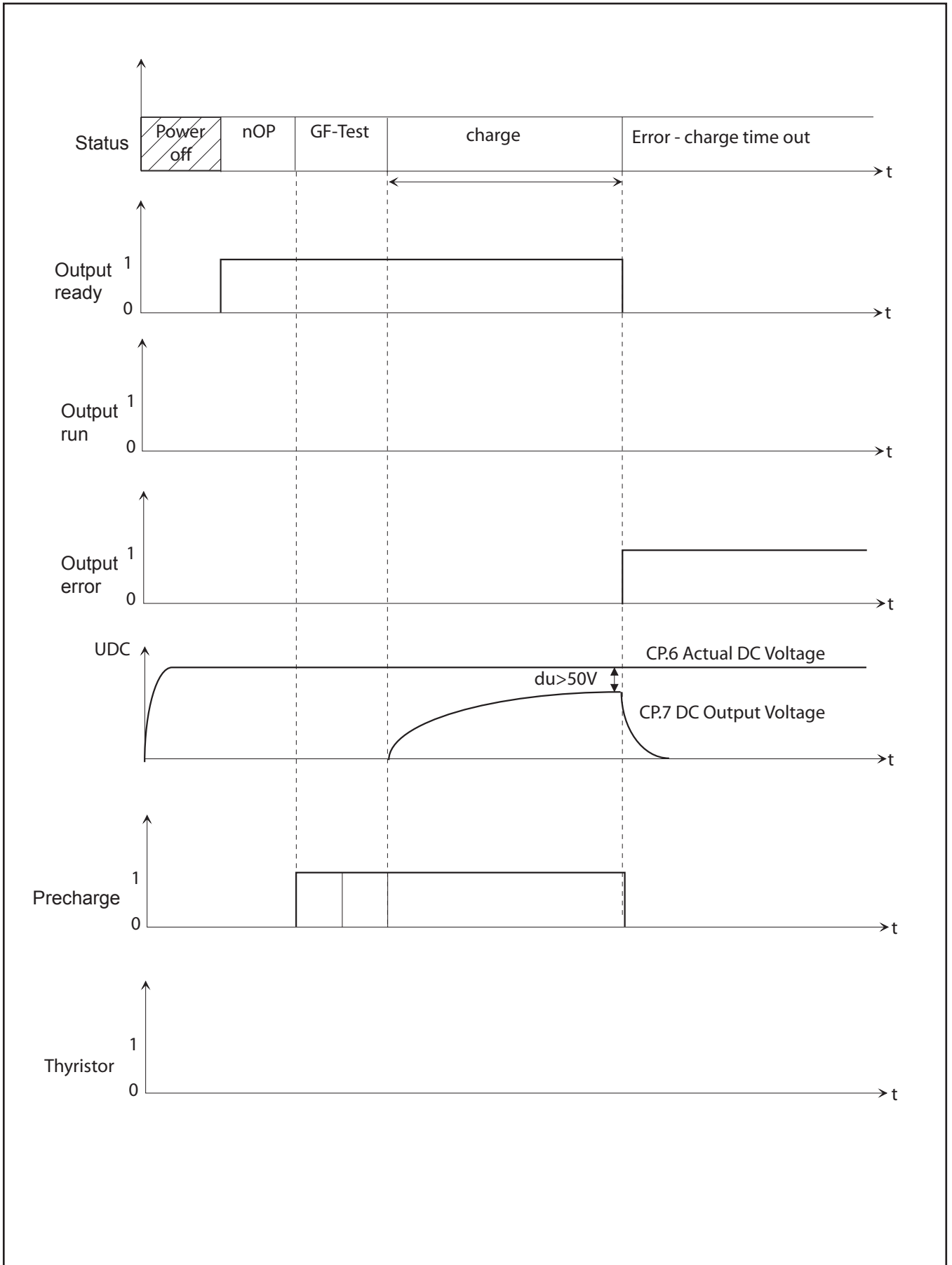


6.6.2 Ground Fault during Power-on to +DC

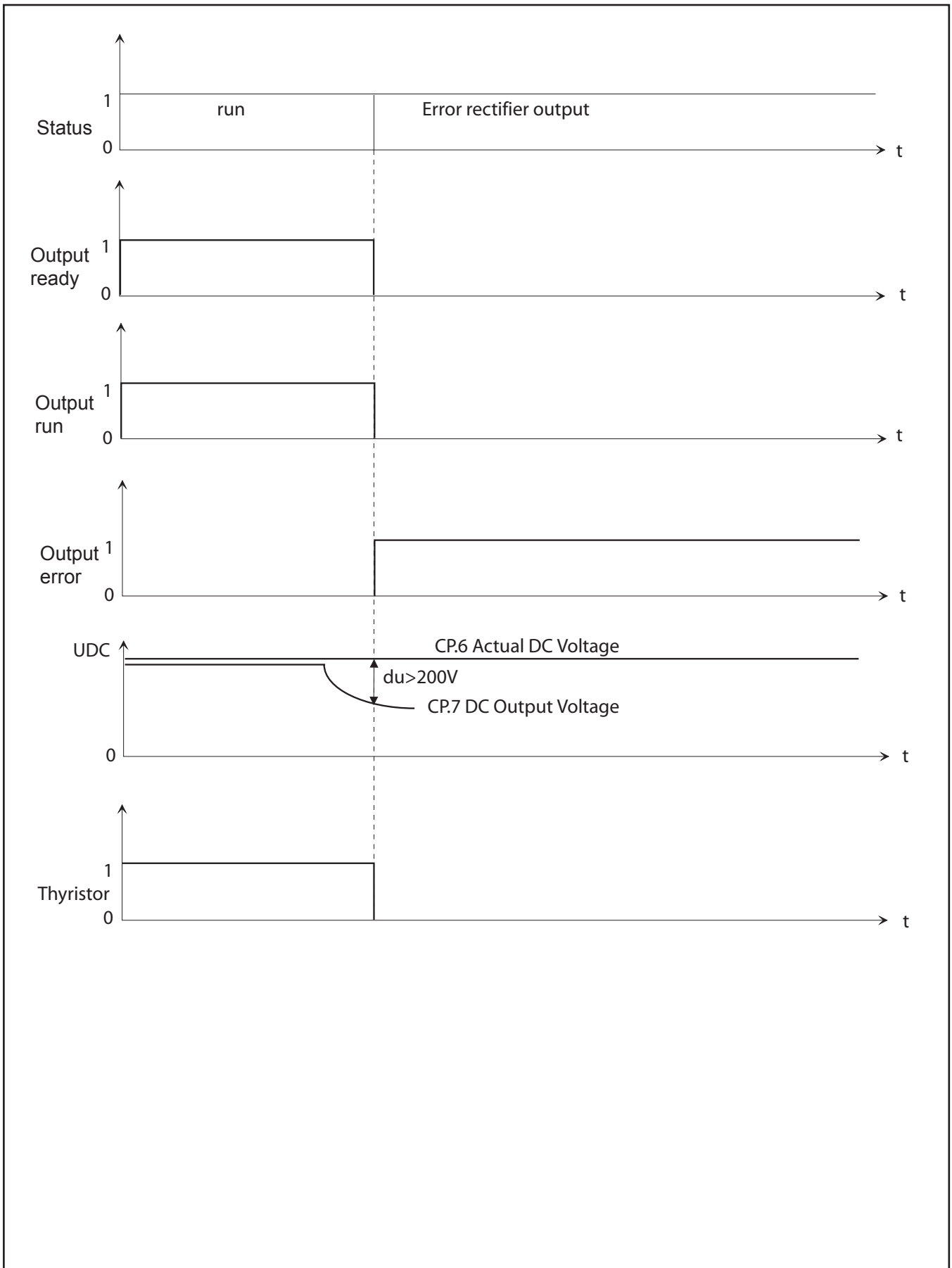


Functional Description

6.6.3 Charge Time Exceeding during Power-on

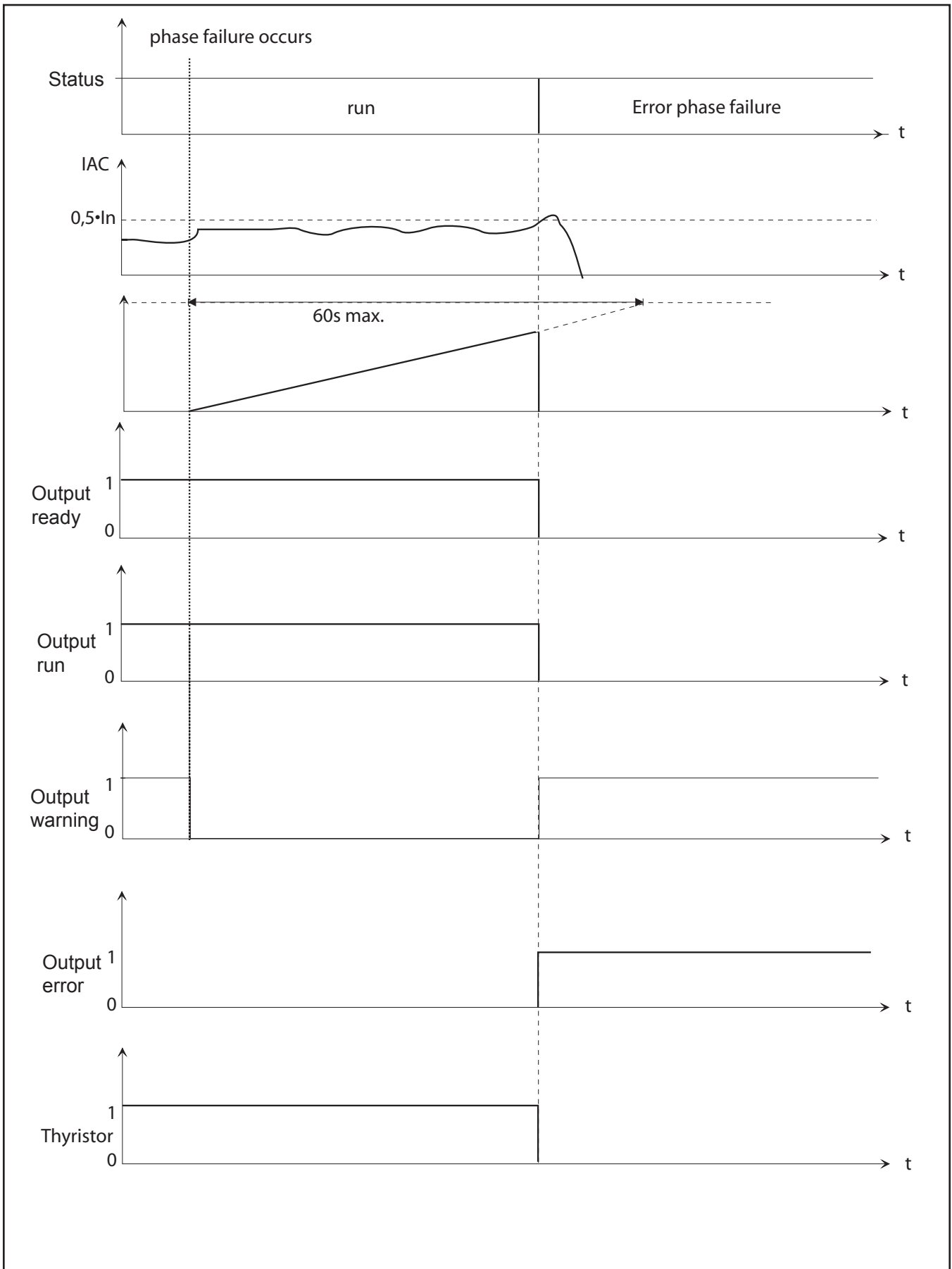


6.6.4 Output error during Operation



Functional Description

6.6.5 Phase Error during Operation





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